IMPACTS AND PROGRAM DELIVERY ASPECTS OF CURRENT ACTIVITIES TO PREVENT SOIL DEGRADATION AND CONSERVE AND IMPROVE SOIL AND WATER RESOURCES FOR AGRICULTURE - KEY FINDINGS AND OVERVIEW OF PROGRAMS

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This report is distributed as a working paper for those interested in Canadian agriculture. The findings and views do not necessarily represent the position of Agriculture Canada.

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This report was completed for the Development Coordination Division, Development Policy Directorate, Regional Development Branch, Agriculture Canada, to provide input to a review of agricultural soil and water issues in the Canadian Prairies.

The list of reports on this subject are as follows:

1. Agricultural Land Degradation in Western Canada: A Physical and Economic Overview

2. Prairie Agricultural Development Directions

3. How Specific Federal Policies May Impact on Prairie Soil and Moisture Conservation

4. United States Department of Agriculture Soil Conservation Activities on the U.S. Great Plains: Lessons for Agriculture Canada on the Canadian Prairies

5. Impacts and Program Delivery Aspects of Current Activities to Prevent Soil Degradation and Conserve and Improve Soil and Water Resources for Agriculture - Key Findings and Overview of Programs

6. An Overview of the Technology Transfer Systems for Soil and Water Conservation Practices in Western Canada and The United States

October, 1984

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Executive Summary and Key Findings

At the request of the Regional Development Branch, Agriculture Canada, International Enterprise Group Ltd. undertook an evaluation of extent to which a range of soil and water conservation-related programs, projects and activities (pre-selected by the client) were contributing to the prevention of soil degradation and the conservation and improvement of soil and water resources in Western Canada. The client divided the program, projects and activities to be evaluated into the following three broad functional categories:

1. Survey/Monitoring/Mapping
2. Research
3. Technology Transfer

The consulting team was interdisciplinary in character, incorporating the following backgrounds:

- Program evaluation
- Policy development
- On-farm management experience
- Agricultural economics
- Marketing
- Soil science and Agrology
- Research administration
- Technology transfer (i.e. extension work and farm management work in Western Canada).

Two of the team members were farmers in their own right.

The methodological foundation of this project consisted of an expert/participant poll using interview checklists. Interviewees included policy makers, research scientists, technicians, extension personnel, farmers and "outside experts" (the last group included private consultants, retired scientists and others). Appendix 1 contains the interview checklists that were employed for various categories of interviewees.

The open-ended responses to our poll were distilled and summarized for analytical purposes using matrices drawn up for each program under examination. These matrices, along with individual program evaluation profiles, were provided under separate cover to the client.

Aside from the expert/participant poll, consultants also undertook a fairly extensive review of a wide variety of reports, memoranda, operational plans, newsletters, scholarly articles, briefs, pamphlets etc., from both public and private sources. A partial list of references is provided in Appendix 2 of this report.

The evaluated programs, projects and activities do not, in themselves, constitute a comprehensive sweep of the soils effort in Western Canada. Rather, they represent areas judged by the Client (a), to be particularly representative of the overall mix of soils-related activity in Western Canada and (b), to constitute relatively (our emphasis) significant commitments of resources. Consultants were also invited by the Client to single out other activities, which, as a result of our investigations, we deemed worthy of mention.

This final report incorporates broad findings based on an analysis of the individual programs, projects and activities already provided to the client.

Some General Findings

1. Relative to the perceived seriousness of the problem, the resources directed into soil and moisture conservation and improvement in the West are inadequate.
2. Unless a program, project or activity was taking place within their province or area, respondents not directly involved with that program tended to have only very sketchy knowledge of it. This means that particularly innovative and successful approaches to survey/monitoring/mapping, research or technology transfer are not being effectively diffused across Western Canada.

Key Findings - Survey/Monitoring/Mapping

3. There is reason for concern that the level of resources devoted to mapping and the specific approaches being taken do not optimize the return from the invested resources.
4. At present, insufficient formalized and systematic consultation exists between map makers and potential end-users. Consultants found that the correspondence between the nomenclature, scale etc., of maps and the needs of putative end-users was often only partial at best. There were very few examples of careful targeting of resources through the kind of formal consultative mechanisms that are required in order to ensure that the activities of surveyors and mappers correspond to the practical needs of farmers, extension workers, policy makers and researchers.

Key Findings - Research

5. It is very difficult to measure the on-farm impacts of research on soil and moisture conservation. Many of the impacts of basic and applied research are long-term in nature due to (a) the long lead times involved in basic research and (b) the extreme site-specificity and complexity of factors involved in applied work. Additionally, much of the actual on-farm adoption of minimum and zero till and continuous cropping in Western Canada was rooted in the early adoption which took place in the United States.
6. There is a continuing need to move existing findings "out of the files and into the field". This does not, however, mean that either basic or applied research should be capped, cutback or somehow shifted to technology transfer. Indeed, soil and moisture conservation research remains underfunded relative to its downstream importance.
7. The relevance and utility of basic research carried out is best maximized by ensuring that planning and administrative

mechanisms at the station level cause the results of highly applied, site-specific research to feedback into and influence the thrust of basic research. Very few research units examined in this study are making a conscious, formalized effort to do this.

8. The highly systemic and site-specific character of research related to soil and moisture conservation dictates that research priorities must be geared to (a) emphasizing the interdisciplinary study of soil as a system in basic research and (b) the extensive (across agro-climatic zones) and intensive (many replications within each zone) use of on-farm applied research. This is because there remains a basic lack of understanding of the subtle inter-relationships between hydrology, soil chemistry, soil physics, biota etc., which are crucial to the successful design and application of a given mitigating technology.
9. Respondents, both in Ottawa and the Regions, opined that there is a bias in the career development system away from mission-oriented research, and towards production and dissemination of research geared to academic forums. This bias, along with the lack of formal correspondence between basic and applied research, carries with it the very real problem of taxpayers funding some research which is purely "academic" in nature, in that it carries with it little in the way of potential downstream, on-farm impacts. The peer review process as currently constituted attaches far less weight to interaction with farmers than it does to journal publication or participation in academic congresses and symposia.
10. Scientists lack the travel budgets required to compare notes with their colleagues in other regions.
11. Scientists at federal research stations who are willing and

able to adapt and refine their findings using actual, on-farm situations are often hampered by a lack of equipment, research assistants and other resources.

12. Soil conservation-oriented research does not possess a strong, vocal constituency among users of that research due to the fact that economic benefits (or conversely, the costs of curtailing it through underfunding) are subtle and less immediate than for such areas as pest control, plant breeding etc. This means that the kind of momentum required to enlist support for increased funding levels for conservation-oriented research at the uppermost administrative and political levels is often lacking.
13. The level of efficiency with which research is carried out appears to be generally quite high: research stations, particularly the smaller ones, are making judicious use of very limited budgets for conservation-oriented research.
14. The rationale for research which seems purely academic in nature by virtue of its essentially tangential relationship to degradation problems, or its reliance upon questionable forecasting models or equations, tends to be weak, given the limited funds available for conservation research.
15. On balance, researchers and some administrators in the field thought that existing planning systems could be fine tuned with a view to cutting back on paper work and largely symbolic attempts to quantify future productivity gains from existing and proposed projects. Additionally, it was felt that CASSC did not satisfactorily translate research thrusts perceived as priorities in the regions into action at the federal level.
16. On the basis of this "broad-brush" evaluation, consultants have concluded that further investigation into improving the existing system of research planning is warranted.
17. Most respondents felt that regionalization of research administration as presently constituted was not providing researchers and station administrators with sufficient flexibility in the setting of priorities and the allocation of funds.

18. Concern was also expressed over the duplication of effort caused by red tape which, in turn, had its origins in regionalization.
19. In accordance with findings 17 and 18, a detailed study of how best to make regionalization work, coupled to the study of the planning process suggested above, is also required.

Key Findings - Technology Transfer

20. There is a tendency on the part of most federal and provincial decision-makers to equate technology transfer with the simple provision of information to farmers.
21. Following from 20, not enough consideration has been given to ensuring an approach to technology transfer which systematically links all of the components necessary for the successful adoption of soil conservation mitigating technologies, as outlined in Figure 1, Section 2.
22. Research must be considered not only as an activity in and of itself, but also as part and parcel of the technology transfer process. The quality and relevance of research results will influence their downstream adoption by farmers. Likewise, the technology transfer process provides an underutilized feedback loop back into the research process itself.
23. Highly trained soil specialists, not agricultural representatives (or district agriculturalists), will have to be on "the front lines" of delivering soil conservation techniques and technologies to farmers, given the highly systemic, knowledge-intensive nature of the technologies and management methods required to mitigate soil degradation. There is an acute shortage of provincially-hired soil specialists in every Western Province including Alberta (which possesses the largest number).
24. All extension personnel require periodic professional upgrading courses in order to be kept abreast of new findings in conservation-related research and technology transfer techniques, particularly findings obtained outside their

region and province. At present, formal upgrading programs appear to be either lacking or inadequate.

25. Very little or no systematic empirical research has been carried out into (a), factors governing adoption rates (b), actual adoption rates for various conservation technologies and techniques and (c), matching of adoption rates to various types of technology transfer mechanisms (both private and public) in Western Canada. Research geared to the differing agro-climatic regions in Western Canada, and carried out in a manner which will provide a basis for the development of a "marketing strategy" for soil conservation, would be timely.

26. Private manufacturers and consultants are playing an increasingly important role in delivering conservation farming techniques to farmers. Their potential contribution is not yet being taken into account in the design of programs related to survey/mapping, applied research and transfer of conservation farming techniques.

27. Canada's federal system produces an artificial division between research and technology transfer. Institutes which straddle research and technology transfer can bridge that division and provide policy makers at all levels of government with the means of fine-tuning over time federal/provincial/municipal interaction in soil and moisture conservation-related work. The Saskatchewan Institute of Pedology provides a particularly successful example of the conscious integration of basic research, applied research and technology transfer.

28. The division of labour between PFRA and the Province of Alberta in the delivery of salinity mitigating programs in that province is presently not formally defined. If funding levels for technology transfer and land improvement programs increase, the danger exists that significant levels of inefficiency, born out of overlap, could set in.

29. There is considerable overlap and duplication in the sheer quantity of generalized field days and lectures taking place

in a given season, in some agricultural districts. Some of these resources would be best diverted towards working intensively with individual farmers, or groups of farmers in actual implementation of conservation-based techniques.

Key Findings - Economic Issues

30. Little research into the actual on-farm economic impacts of various projects, programs or activities is currently taking place at the federal or provincial levels. Consultants have the following general observations to make regarding economic factors governing the adoption of conservation farming practices by farmers:

31. As illustrated in Figure 2, Section 2 of this report, soil and moisture problems and the economic consequences of mitigating those problems vary widely from farm to farm, even within a given district.

32. The most difficult economic trade-off confronting farmers consists of the choice between adopting new conservation-oriented systems which have highly uncertain cash-flow consequences in the short-term, but which have a medium- and long-term potential for enhancing soil productivity and output. Farmers who have adopted conservation practices have, in many cases, suffered with respect to cash flow relative to their neighbours who are still employing summer fallow-based soil mining. At the same time, however, there is some preliminary evidence, based on land values as determined by the real estate market, to suggest that farmers practicing salinity control may be enhancing or protecting their land-based net-worth, relative to farmers still tied to summer fallow.

33. Little currently exists by way of economic incentives which would serve to mitigate front-end risks for farmers. The most glaring weakness consists of the general inadequacy of crop insurance protection currently available. Presently summer fallow constitutes a de facto form of drought insurance.

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34. Depressed world markets, marketing of grains and Wheat Board quotas constitute key obstacles to the adoption of conservation practices which increase yields and/or generate higher production costs. In the absence of markets and attractive prices for grains, conservation farming will be blocked by farmers who, in order to weather their low returns on investment, must keep their short-term bottom line paramount in their thinking.

Key Findings - Knowledge Gaps

35. Understanding of the actual on-farm economic impact of conservation farming techniques remains a serious knowledge gap. Economic analysis should be incorporated into applied scientific research to a much greater extent than is currently the case, not only to ascertain whether the approaches being tested are economically viable, but also with a view to modifying those approaches in order to increase their financial attractiveness to farmers.

Impacts and Program Delivery Aspects of Current Activities to Prevent Soil Degration and Conserve and Improve Soil and Water Resources for Agriculture

1. Introduction

1.1 Purpose

The overall objective of this study, as defined in Appendix "A" of the contract to consultants, dated July 18th, 1984, was stated as follows:

"[to] determine the economic efficiency and effectiveness and to assess the environmental impact of current activities on the Prairies which deal directly with soil and moisture conservation".

In their proposal to the client, consultants identified a number of key evaluation issues:

(1) A precise identification of intended objectives of the programs and activities separately by types (research, survey/monitoring/mapping or tech transfer), by problem category, by geographical area, etc. and identification of where goals may not have been sufficiently well-defined at the front-end;

(2) the identification of verifiable performance indicators, by activity type and province. Ideally, the programs will, in some instances, already have these in place;

(3) an assessment of the varying degrees to which the activities and programs under scrutiny address the problem areas and more fundamentally, the extent to which the program goals themselves are addressing problems squarely (project, program or activity rationale);

(4) a province by province assessment of results;

(5) an assessment of the overall efficiency with which programs are carried out, including an assessment of approaches to program delivery;

(6) the determination of whether or not the present "menu" of programs collectively addresses these issues in a sufficiently focussed manner or whether a diffusion or dilution of energy has occurred, borne out of an "ad hoc", evolutionary pattern of soil policy development;

(7) the determination of whether programs, projects or activities, particularly in the technology transfer field clash in any way, thus cancelling each other out with respect to their impact on client groups and dissipating departmental energies and resources;

(8) the identification of knowledge and program delivery gaps in the existing range of programs, projects and activities.

These evaluation issues were agreed upon by the client, and serve as a basis for the evaluation which follows.

Pages 3 and 4 list the programs pre-selected by the client for evaluation.

1.2 Study Team

The consulting team was interdisciplinary in character, incorporating the following backgrounds:

- Program evaluation
- Policy development
- On-farm management experience
- Agricultural economics
- Marketing
- Soil science and Agrology
- Research administration
- Technology transfer (i.e. extension and farm management work in Western Canada).

Two of the team members were farmers in their own right.

Individual Programs Evaluated in This Study

Organization	Activity or Program	Issues Dealt With	Geographic Area
Manitoba Dept. of Natural Resources, Winnipeg	Conservation Districts and related programs	Water & wind erosion	Whitemud Turtle River
Canada-Manitoba Soil Survey, Winnipeg	Mapping and evaluating soil's salinity	Disturbance, Salinity, Erosion, Organic depletion, Compaction, Acidification	Southern Manitoba
Agriculture Canada Research Canada Swift Current	Salt-resistant crops	Salinity, Moisture conservation, Erosion	Southwestern Saskatchewan
Prairie Farm Rehabilitation Administration, Regina	Community Pasture Program, Tree Nursery Program, Land degradation appraisal, Salinity diagnostic service, Technical services	Erosion Manitoba, Wind erosion Degradation Water Use, Salinity, Erosion	Agricultural Saskatchewan, & Alberta
Sask. Inst. of Pedology Univ. of Sask. Saskatoon	Innovative Farm Lab	Organic matter loss, Erosion, Salinity, Acidification, Disturbance, Contamination	Saskatchewan
Ag. Can. Research Station Lethbridge Soil conservation	Irrigation drainage Desalinization Reduced tillage, Irrigation problems	O.M. loss wind erosion Salinity	Southern Alberta
Ag. Can. Research Stn. Lacombe	Amelioration of Solonetzic soils	Solonetzic soils	Central Alberta
Alberta Ag. Edmonton	Dryland Salinity Control Assoc.	Salinity	Warner County
	Soil Conservation Area Program	Erosion, Salinity	Alberta
Alberta Environment	Land Reclamation	Soil compaction	Alberta
Land Resources Research Inst. Soil Survey	Resource Protection Program, Soil Survey Program	All aspects of land degradation	Prairie Provinces and B.C.

U. of B.C. Dept. of Soil Sciences Vancouver	Mulches & tillage effects on soil temperature and moisture	Water erosion	Peace River District
Alberta Inst. of Pedology	Mapping and evaluating soils	Salinity, Erosion, Organic depletion, Acidification, Disturbance	Alberta
Ag. Can. Research Stn. Beaverlodge	Soil management	Erosion, Acidity	Peace River District
Ag. Can. Soil Survey, Vancouver	Soil mapping and evaluation	Soil erosion	Peace River District
Ag. Can. Research Branch Prairie Region	Program Administration and coordination	All issues	Prairie Provinces

Team members were:

John Wanczycki, Team Leader, Ottawa.
August Saaltink, Toronto.
Wayne Gamble, Saskatoon.
J. Wallace Hamm, Saskatoon.
Paul Muller, Ottawa.
Additional analytical assistance was provided by Robert Bens, also of Saskatoon.

1.3 Scope of the Project

In large part, the evaluation issues developed by the consultant and quoted above define the scope of the project. However, it will be useful to note some of the points made under Scope in Appendix 8 of the Contract. The consultants were asked to focus their attention on a number of evaluation issues.

To begin with, we were asked to assess the impacts of current federal, provincial and private activities from the standpoints of both their economic and environmental impacts on the soil degradation problem. Where possible, quantitative performance indicators would be identified or derived to more precisely measure these impacts. Due, however, to a paucity of hard data, or alternatively, the very preliminary nature of some of the long-range work taking place under the rubric of these programs, the derivation of precise, uniform measurement tools to evaluate them was often both impossible and inappropriate. By way of example, long-range research seldom yields near-term, tangible impacts. One can, however, make some assessment of the relevance or utility of such research. This the consultants have done by means of an expert-participant polling technique and the arraying of responses obtained in interviews on to evaluation matrices.

Also, in accordance with the project scope outlined in Appendix A of the Contract, consultants endeavoured to "indicate how well goals are being achieved and how issues are being addressed relative to the agencies available resource base; the delivery approach... and also the degree of clients' participation". Obviously, in some instances, goals and objectives may be difficult to define

except in the broadest possible terms. As well, objectives and accomplishments of various programs could conceivably be assessed against a whole range of possible criteria. At the outset of the project, prior to field visits, the client and consultant agreed that as much as possible, the evaluation as a whole and questions posed during interviews should use the question of actual on-farm impacts as a key element in evaluating individual programs, projects, activities. The aforementioned lack of available hard data often made such assessments difficult. Also, there is an element of unfairness inherent in dealing with the question of on-farm impacts for long-term research in the same way as one would, say, for a technology transfer program. Nevertheless, for purposes of attempting to make some kind of objective, policy-relevant evaluation of programs designed to combat soil degradation, the "actual on-farm impact" approach was one practical analytical pivot around which a varied collection of programs, projects and activities could be evaluated within a limited period.

Again, under Scope, the client anticipated the probable shortage of hard data and thus waved any requirement for an extensive data base, relying instead on the "analysis and synthesis of expert knowledge on the process and content of the investigative initiatives (which) will be required in the Report" [Appendix "A"]. If a data base could be constructed, so much the better. In any event, consultants suggested the issues matrix approach in order to analyse, in a balanced and well-modulated manner, the views of a host of respondents regarding a cluster of program evaluation issues.

Finally, the consultants were asked to "make recommendations on how to fill knowledge gaps which currently exist in the evaluation of soil and moisture conservation programs by keying on specific programs or projects identified in Module 3". This issue is addressed in Section 4 of this Report.

1.4 Methodology

In accordance with the requirements of the project, the evaluation took, in large part, the form of an expert-participant opinion poll, "supported by an analysis and interpretation of available

program evaluations or project assessments".[1]

Interview checklists were drawn up and ratified by the client. They served as the prime basis upon which consultants extracted analytical insights over the course of the study. The interview checklists are provided in Appendix 1 of this report.

The results of interviews were superimposed upon an evaluation matrix drawn up for each evaluated program. In some cases, more than one evaluation matrix was employed for a given program when consultants deemed it appropriate to subdivide it into various discrete sub-activities or projects, each of which seemed to warrant a separate analysis.

In their investigation, consultants also referred to a large body of documentation pertaining to individual programs, overall departmental policies, findings generated at research stations, monographs and publications dealing with soil problems, farm conservation newsletters, brochures of corporations involved in the sale of mitigating technologies, etc. A list of principal references is provided in Appendix 2 of this report.

Field interviews began in late July and continued for approximately two and a half weeks. Following that date, individual visits continued to be made by Western team members. Additionally, telephone calls were made right up until the time of the drafting of the report, in order to obtain information from respondents not available for various reasons during the field trips, and/or to elicit clarifications.

1.5 Study Constraints

The prime constraints affecting this study were those of time and financial resources at the disposal of consultants. Evaluating the views of a diversity of actors either directly or indirectly involved or affected by a range of programs in four western provinces meant that, in keeping with the proposal first put forward by consultants, a broad

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[1] Page 1, Appendix A Contract.

brush approach to this evaluation was the only realistic option. The schedule of visits to research stations and other locales was a highly intensive one and more often than not, had to be followed up with additional telephone interviews in order to contact people who were either unavailable at the time or whose availability conflicted with a necessarily tight travel schedule. Also, summer holidays were a factor to be taken into account when attempting to arrange interviews with officials. Finally, farmers were often difficult to reach due to harvesting. Nevertheless, consultants feel that a balanced range of views from key actors was obtained. Moreover, consultants were struck at times by the strong consensus of views which tended to prevail regarding aspects of individual programs. This facilitated the task of obtaining a balanced, representative sample of opinion.

1.6 Outline of the Study

In an earlier version of this report, consultants included thumbnail profiles of the various programs under evaluation in this study. These sketches focus on the objectives, achievements, physical (actual environmental) impacts and rationale of each program. Each profile was distilled from the analytical matrices summarizing interview results for each program. These matrices were also provided to the client.

In this report, the consultants have extracted some of the findings contained in the profiles and included them in the overall assessment of programs by generic type (survey/monitoring, research [including highly applied research] and technology transfer).

2. Overview of Programs by Type

2.1 Survey/Monitoring/Mapping Programs

Soil survey programs gather and organize information on soil characteristics. Since the information is usually communicated in the form of two dimensional maps, the term "mapping" will be used in this report as a shorthand for the full survey/monitoring/mapping cycle of activities.

The actual steps involved in the soil survey program include project planning, fieldwork, compilation of data, map making, report writing, and publication of maps and reports. In addition, there is ongoing work to improve classification schemes as well as data collection and compilation techniques, so as to enhance the accuracy of the conclusions drawn from the soil characteristics, and otherwise improve the process. The consulting team's terms of reference included assessing the economic and environmental impacts of the following monitoring/surveying programs:

Land Resource Research Institute Soil Survey
- Soil Survey Saving Program (Prairies, B.C.)

Agriculture Canada Soil Survey, Vancouver
- Soil mapping and evaluation (Peace River District)

Alberta Institute of Pedology
- Mapping and evaluating soils (Alberta)

Canada-Manitoba Soil Survey
- Mapping and evaluating soil salinity (Southern Manitoba)

The Alberta and Manitoba programs are closely affiliated with, and partly funded and staffed by the Land Resources Research Institute. The B.C. Pedology Unit is wholly an L.R.R.I. unit, but it works in close cooperation with the provincial soil survey unit. However, it is located in Vancouver, whereas the provincial unit is based in Victoria.

The first key question for which the project team sought opinions was: "what are the potential benefits from surveying, monitoring and mapping and how do they come about?"

Mapping is undertaken in order to provide multiple benefits to multiple groups. The ostensible benefits from monitoring/surveying/ mapping include: higher farm net income, reduced soil degradation, more cost-effective extension work, better targeted and/or more cost-effective research, better and/or more cost-effective policy-making and program management, a more efficient real estate market, and finally, essentially academic insight into soils. Because the purported uses and benefits are many and varied, it will be helpful to review them one by one.

2.1.1 Perceived Utility as Reflected in Interviews

A. Usefulness to Farmers

Possible benefits to individual farmers from mapping would accrue through the use of maps in guiding farmer decisions regarding what portions of their land to crop, the kinds of rotations to be used, tillage practices, fertilization, etc. However, extensive enquiries indicated that farmers tend not to use soil survey data or soil survey maps, except when purchasing additional land. A farmer traverses his fields intensively and repeatedly. Over time, many know more about their soils and their condition than any general soil survey could reveal. Thus general surveys may not provide a substantial percentage of farmers, particularly better educated ones, with very much useful information.

Most farmers interviewed for this assignment had no hesitation in discussing their soils and their properties using their series names ("Well, I have Osbourne Clay, Red River Clay, Sperling Loam, and some Riverdale Silty Clay-Loam on my farm."). However, there are, according to some respondents, a certain percentage of farmers who are not familiar with the technical names of the soil types on their properties, or with the other geo-physical characteristics of their farmland. For this latter group, reference to soil maps is ostensibly useful, in that it allows them to interpret the applicability of cropping recommendations to their personal situations.

When looking for land, some farmers use the CLI maps for clues as to where to find land with high agricultural capability. Of course they must always use them in concert with a personal inspection.

Finally, some municipal assessment maps may be eminently suitable for farmers for such management matters as field orientation relative to erosion and salinity, land productivity and other matters.

B. Farmer Advisors

One set of potential benefits from soil mapping could flow from the usefulness of the maps to people who advise farmers on management matters. Individuals who are approached by farmers for advice on crops and management practices include agriculture representatives, district agriculturalists, soil specialists, scientists in universities and research stations, and representatives from fertilizer and chemical firms. They sometimes provide advice over the telephone, and base their recommendations on what the farmer can tell them about his land and on what they can infer from soil maps. Many of these farmer advisors were asked about the usefulness of soil survey maps; most of them said that they were helpful. And, the more accurate and detailed, the more useful they were. Yet, many respondents stated that they were very reluctant to give serious advice based on any survey other than an in-person visit, often combined with soil sample tests. Over-reliance on soil survey maps, no matter how detailed, as a basis for farmer advice is allegedly a risky business. It can carry with it grave negative consequences for the farmer because of the often extreme variability in local soil and moisture conditions.

In the absence of detailed and comprehensive soil survey programs, farmer advisors would probably do more site-specific sampling and analysis before giving advice. This could also significantly increase the value of the advice. By allowing experts to (a), address specific problems and opportunities at the farm and field levels, and (b), match possible techniques to their assessment of the management capabilities of individual farmers, the potential for positive impacts on yields would be enhanced and the downside risk of giving advice which could result in yield and financial losses to the farmer would be correspondingly lowered. (For example, the use of longer rotations and

reduced tillage may require more capital and more sophisticated management and decision-making than some farmers can handle; recommending such approaches to the wrong farmers can prove costly to the farmer and reflect badly on what are, otherwise, very valid approaches.)

One innovative alternative to putting limited resources into better general soil surveys and mapping was brought to the attention of the project team. It offers not only an opportunity to increase yields, improve farm incomes, and combat soil degradation by advising on issues such as drainage, tillage reduction, and improved rotations, but also a chance to address knoll erosion and valley salinity.

This approach involves farm-specific analysis, in addition to consultation with farmers on a one-to-one basis. It included infrared photography of a farm on a field by field basis, coupled with on-the-ground inspections by an expert agronomist who can interpret the photographs and results of field inspections in tandem. Working with the farmer, he or she can design a farm management plan including recommendations on a field-by-field basis for cropping, rotation, tillage practices, and variable-rate fertilization.

By optimizing fertilizer use, cropping, and tillage in each field, farmers would, in general, realize significant savings in their cost per unit of crop produced. From the perspective of soil degradation, they could reduce the tendency to underutilize knoll moisture (which leads to excessive erosion of knolls and increased salinity elsewhere).

Farm-specific surveys and recommendations appear to be potentially viable as a purely private operation, as the cost savings to farmers would generally outweigh the fees at which the service could be provided. At the existing embryonic stage of this approach, however, some public financing could help break through the current chicken and egg situation where producers want to see the approach tested before they sign up, and potential providers of the service need an opportunity to actually provide it and demonstrate its value. The evolution of a private sector capability would occur in a manner analogous to the development of privately delivered soil diagnostic services in the Prairies.

There is not necessarily any conflict between providing generalized soil survey maps and reports for farmer-advisors and

assisting in the development and demonstration of farm-specific approaches. However, if resources are limited to the extent that farm-specific mapping cannot be pursued without cutting back on general mapping, then a redirection of funds would, based on the information currently available to the study team, be highly desirable.

C. Improved Policymaking

Another important expected benefit from soil surveying and mapping consists of its contribution to the policy-making process, including such decisions as development of agricultural programs, farmer education, land-use regulation, environmental regulation, and resource allocation at federal, provincial, municipal and crown corporation levels. In general, the individuals interviewed in this study maintained that surveying/monitoring/mapping contributed to the provision of a knowledge base for policy-making and program development. The rationale for cataloguing soil and monitoring changes in soil conditions is to permit policymakers to assess the current situation and trends over time. In this way, they can determine whether problems exist, the extent, seriousness, and urgency of those problems, and the factors which seem to be associated with desirable and undesirable trends. As one of our respondents put it:

> "If we don't monitor soil conditions, we can suddenly find ourselves in a heap of trouble, where we don't have the knowledge about what's going on."

Policymakers and individuals whose work can impact upon federal and provincial soil-impacting policies and programs were described as a key target group for monitoring and survey programs. One mapper put it as follows:

> "Most of the other government agencies - and an awful lot of consultants - come to us asking for maps and information".

Government departments and agencies using the soil survey maps include Parks Canada, the Department of Indian and Northern Affairs, Provincial Departments of Agriculture, Recreation and Tourism, and Municipal Affairs, municipal planning agencies, crop insurers, etc. In the absence of the soil survey program, they would probably rely more

on the older, less detailed and less accurate maps, and do their own ad hoc inspections on an as-required basis. Their requests for mapping are well in excess of what the available levels of soil surveying can deliver. Indeed, a recent in-house study of mapping priorities showed that at current levels of progress it might take 10 to 30 years to map currently identified priority areas.

D. Usefulness to Researchers

The ostensible benefit of soil mapping to researchers consists of the possible assistance of the maps in helping government, university, and industry researchers in identifying problems or promising areas for research. However, in our poll, researcher respondents suggested that they only used map information when providing advice to farmers.

E. Utility to the General Public

Maps may help individuals involved in real estate, including buyers, sellers, or brokers and thus improve the efficiency of the real estate markets. They are used fairly extensively for this purpose.

F. Contribution to Humanity's Knowledge Base

In theory, the surveys could continue indefinitely with a much higher level of effort, researching more factors in ever-increasing detail in support of the above objective. However, the practical value of all this data collection and analysis is unclear, and its economic and environmental impacts are difficult to assess.

3.1.2 Conclusions Regarding Federal Soil Survey and Mapping Work

A. Awareness of User Needs

The study team assessed the general level of awareness on the part of mappers of the specific uses to which the maps were put and by whom. While mappers could only give some general suggestions about how the maps helped, they believed that user-needs were adequately reflected within the priority setting process. Mappers were certain that the benefits from soil survey and mapping were in excess of costs.

Consultants also sought out information regarding any formal studies of map use that might have been carried out. Most of our respondents did not know whether any such studies existed. The project team was, however, able to locate one report involving a Land Resources Research Institute professional which, in turn, referred to an unpublished MA thesis done at the University of Guelph, an Australian study, and a further study of Southern Ontario.[2] User categories interviewed included assessors, agriculturalists, planners, land managers, engineers, foresters, biologists, and "others". This study did not probe the impacts of the maps, but focussed rather on information which would help mappers decide how to improve legends, symbols, and map base. The study included the following findings:

(1) Excluding interpretive information [such as agricultural potential], the major soil characteristics of interest to users were texture, slope, and moisture. Minerology and chemical data were ranked low. In another study which included interpretive information, agriculture capability ranked highest in interest, followed by soil texture and soil productivity. Respondents voiced an antipathy to traditional soil taxonomic terms.

(2) Fully 51 percent of respondents had difficulty getting the information they needed from a soil map.

(3) Quick delivery was more important than precision to two-thirds of the users. Sixty-five percent of the respondents preferred a less precise map which would be available in 1 year to a more precise one available in 4 years.

Thus, a great deal of information developed at great expense would appear to be of little utility to large number of end-users. Easily generated maps were favoured over slower to produce, highly detailed maps by a margin of 2 to 1.

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2. K.W.G. Valentine, W.C. Naughton and M. Mavai, "A Questionnaire to Users of Soil Maps in British Columbia: Results and Implications for Design and Contents" Canadian Journal of Soil Science, 61: 123-135, February 1981.

Due to the lack of research conducted to date into the economic value of the maps (e.g. did they save the users money, or otherwise increase economic efficiency?) there has been little basis for assessing the net economic benefits of mapping. On the basis of our poll, however, consultants have concluded that there is strong reason for concern that the level of resources devoted to mapping, and the specific approaches being taken, do not optimize the return from the invested resource. The question of how costs should be allocated, and how much benefit actually flows through to the agricultural system and/or to the soil itself is one which does not seem to have been properly addressed.

D. General Evaluation

As we have seen, mapping is very difficult to evaluate since it is one activity which is purported to serve a variety of needs on the part of many users. Assessing the benefits of mapping thus bears some resemblance to the task of assessing the benefits of a highway, which may have economic, social, environmental, defense and other (e.g. "national unity") benefits. It is conceivable that even if soil surveys and mapping had little or no beneficial effects on agriculture and soil, the activity could still be worthwhile because of some other benefits, such as better recreational, municipal development, and transportation planning. For the purposes of this study, the focus mandated in the Terms of Reference was principally on soil degradation. Thus the following conclusions relate primarily to the agricultural and soil impacts.

On the basis of the interviews, consultants are sceptical regarding the vaunted environmental and economic benefits of continuing work to produce even more detailed general maps. Our investigations served to highlight the apparent limitations of general maps for all uses except policymaking: policy-makers and planners do apparently, find these maps useful. It should be kept in mind, however, that unless or until policies are adopted protecting, by way of example, erosion-prone lands, the production of erosion sensitivity maps may not have a great deal of practical value. Likewise, the production of salinity maps may fulfill a "consciousness-raising" function by

highlighting the extent of the problem. This will, however, have to be followed up by concrete initiatives with actual on-farm impacts. Therefore, given the fact that soil conservation as a whole is chronically underfunded, further allocation of funds to mapping with soil conservation and improvement in mind should be examined from the standpoint of competing potential uses in research, site-specific diagnostics, and technology transfer.

Consultants are hard-pressed to reach conclusions regarding the efficiency with which surveying, monitoring and mapping is undertaken. Our interviewees who had firsthand familiarity with the mapping process were generally complimentary regarding the dedication and application of the land inspectors. They were less familiar, or in some cases, less impressed with the process of producing maps and reports. There was some criticism to the effect that some of the soil factors surveyed were not useful for developing interpretations. Apparently, however, significant steps have been taken to rationalize soil inspection criteria and processes. Team members believe that in the interests of improving the cost-effectiveness of the process, some experimental contracting-out of soil survey projects (perhaps for a county or two) should be considered, with a view to assessing whether the cost per area surveyed differs significantly from that done in-house.

More fundamentally, it is not clear that the present "product" produced by the soil survey program represents the most cost-effective approach to satisfy the needs of map users, since the actual needs of map users and the actual uses to which the maps are put are not, apparently, very well known. Since mapping involves working with soil and data much more than working with users, many of the individuals involved in the mapping process seem to be much more process-fixated than individuals, for instance, working in technology transfer or highly applied research. Possibly due in part to this dynamic, mappers tended to provide rather nebulous rationales for their efforts, relative to research or extension-oriented respondents.

In their investigations, consultants found that the Saskatchewan Institute of Pedology provided the only instance of where a conscious, ongoing and formalized mechanism is in place, in order to

make mappers consult with end-users with a view to tailoring their work to real needs. The result of this consultative exercise is the ongoing production of maps for individual municipalities, which provide information regarding soil structure (in simplified terminology) topography, salinity, fertility (again simplified) and erosion susceptibility. These maps are, apparently, sought after by farmers.

If our findings stir some controversy and cause people to clarify the purposes of mapping and search for demonstrable benefits, then the study team feels that it will have made a worthwhile contribution.

While the overall level of funding going to soil mapping warrants examination, the balance of resources allocated to the different aspects of the Land Resources Research Institute's work might also bear review. As of 1981 there were 7 professionals involved in "Soil Classification" and a further 7 in "Land Use and Evaluation", compared to 42 involved in "Soil Resource Inventory and Mapping". Some of the work undertaken by these groups might be judged as being of purely academic interest. Passages from reports along the lines of "Analysis of Podzolic pedon developed from chlorite schist in New Brunswick supported evidence in laboratory studies in showing that chlorite is transformed to smectite in the Ae horizon" raised questions as to the ultimate on-farm application of some of the work carried out. This type of basic research may have a legitimate role, but given the severe and deleterious constraints on the mission-oriented work being done at some of the Prairie research stations visited, and the widely-acknowledged need for more resources for extension and other technology transfer work, the study team recommends that resource allocations be reviewed and that individual L.R.R.I. programs be assessed rigorously on the basis of direct or indirect on-farm utility.

2.2 Research

2.2.1 The "Division of Labour" in Research

Perhaps the most common theme arising in interviews with researchers, farmers, extension workers and outside experts revolved around the notion that soil conservation problems are multi-faceted and site-specific. Accordingly, they ultimately require a multi-

disciplinary, systems-oriented approach to problem-solving in order to produce eventual practical implementation in the field. This will involve a combination of basic and applied research, all of which tends to be long-term in nature.

To a large extent, long-term research falls to the federal government by default. Private sector or corporation-based research tends to be narrow and requires a very tangible payoff. Little of it is systems-oriented. University research tends to be short-term by virtue of the study periods of students and the publishing requirements of academics. Also, their research may not (or arguably need not) always be particularly relevant. The quality or rigour of research conducted by farmers is limited by lack of controls. Farm organizations are circumscribed by funding. Provincial research tends to be extremely applied, in some cases verging on public works.

The federal government must and does take a leading role in the design and implementation of long-term, systems-oriented research.

2.2.2 Impact of Research

In some ways, it is more difficult to gauge the actual on-farm impacts of research on soil conservation than it is for survey/mapping/monitoring. In the latter case, one can, as we did, canvass opinions regarding the actual uses to which survey/mapping/monitoring may be put. Research is a much more scattershot exercise. Individual projects may or may not bear fruit. Furthermore, research may have very real impacts ten to fifteen years from now but from this vantage point, those impacts are purely hypothetical and hoped for. Highly applied research often carries with it a very strong technology transfer component *à la* Farm Lab or the tillage research taking place at Lethbridge. At the same time, some very applied research is often long-term in nature. Its long-term character stems, in part, from (a), its extreme site-specificity and (b), the complexity of disciplines such as soil biology, chemistry, physics and hydrology being grappled with. An example of this would be research into salinity seep and recharge control in Southern Alberta.

There is also the problem of determining cause and effect. Since, for example, groups of farmers have in some cases been practicing

minimum and zero till techniques in various parts of the Prairies for a few decades, can one really credit existing research underway in minimum and zero till with much in the way of direct, on-farm impacts? The evidence collected in this study would suggest that much of the on-farm adoption of minimum or zero till and continuous cropping was based on pioneering work which took place in Iowa and North Dakota, in the case of tillage designed to combat erosion, or in Montana, in the case of salinity control. Our respondents asserted that to a large extent, farmers had to re-educate Canadian researchers regarding the real world utility of some of the research that was taking place on stations. (At the same time, however, it should be noted that extension workers and farmers often held the work of these researchers, particularly federal personnel, in very high esteem.)

Scientists and farmers both provided us with instances of shifts in the direction of soil research born out of consultations with farmers. Farmers have become increasingly sophisticated in their knowledge of farming techniques and are more often than not well aware of soil problems existing on their land. Both farmers and outside experts indicated that farmers look to scientists for very specific information. They then "fill in the blanks" themselves and integrate this information into their existing operations. They do not expect scientists to be authorities on all aspects of soil issues as they impact upon their farm.

By way of conclusion, it is extremely difficult at this stage to speak of many direct impacts arising from soil research except in certain very highly applied circumstances. There is some evidence, on the basis of interviews, to suggest that in terms of "bang for the research buck", Farm Lab may have had the greatest impact of any single research program on the cultural practices of farmers for a given target farm population and area, within a limited period of time.

2.2.3 Program Design - Targeting of Research

In essence, two major thrusts in soil conservation-related research are required. On one hand, there is a need to get existing findings "out of the files and into the field". Over the years, according to older researchers interviewed for the study, there has been

a steady de-emphasis of research which carried with it a highly practical, extension-oriented flavour. Under the old experimental farm/substation structure, agricultural research tended to carry with it a significant on-farm demonstration component. In the words of one interviewee, "The old approach was to demonstrate what you did. The illustration stage was time-consuming but it also gave you a better presence in the region". The extreme site-specificity of many soils-related problems, most notably salinity, dictates a large number of field experiments. Fieldwork carried out in concert with farmers also has a very strong technology transfer component. Unfortunately, resource cutbacks and realignments have caused some field experiments to be severely curtailed.

At the same time, so little is known about the intricate interrelationships of factors which govern salinity and other soils problems that a tremendous amount of basic research remains to be done. While there is a lot of existing work that can be transferred to farmers, it would be a mistake to conclude that a massive transfer of resources out of basic and into applied research is in order.[3] Extension workers and scientists interviewed in this report emphasized that adoption rates for certain soil degradation mitigating techniques remain limited in some cases for the very good reason that a technique which may work very well on one farmer's field can produce financial ruin on another. Deep ploughing is a case in point. Due to a basic lack of understanding of some of the subtle interrelationships between hydrology, soil chemistry, soil physics, biota etc., scientists, agriculture representatives and farmers alike are sometimes at a loss to explain why a particular technique can prove a resounding success on one farm and a disaster on another.

Consultants were repeatedly told that over the years, the ever-increasing separation of farmers from researchers had brought about

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[3] Note: While mindful of the rather excruciating definitional problems associated with references to "basic" vs. "applied" research, consultants found that these terms inevitably creep into discussions with researchers and research administrators. In other words, "basic" and "applied" do have real operational significance. Therefore, we have elected to reflect the flavour of our discussions with scientists by making use of this differentiation.

a situation whereby a great deal of research being conducted was tangential and solely academic in nature. In our poll, the level of generally perceived relevancy of research to farmers tended to vary by project and individual researcher being referred to in an interview, rather than by station under discussion or respondent category.

Consultants were provided with a number of examples of research which was considered by respondents to be of the "ivory tower" variety, carrying with it little in the way of potential on-farm impacts. Perhaps the most commonly cited example was that of research centering around the prediction of organic loss through the use of the universal soil-loss equation. One analogy provided to consultants was that of the type of predictive tinkering associated with econometric modelling. It was felt that research into organic matter loss was essentially academic in nature, in that organic matter loss could not be directly addressed except in a few instances (such as grey wooded soils). Rather, the build-up of organic matter constituted a by-product of the application of mitigating techniques which directly attacked the causes of O.M. losses.

How can policy makers maximize the likelihood that the basic research that is conducted is, in fact, ultimately relevant to the needs of farmers? One answer, found long ago, is to put stations into small communities where the interaction with local farmers and extension workers provides an impetus to research relevancy. A further answer would appear to lie in the promotion of a multidisciplinary, systems-oriented approach to basic research, coupled with the stepping up of highly applied on-farm research which draws directly from the work being carried out by basic researchers and feeds back in to the basic research process.

A more thematically focused approach to research may also be a key to enhancing its effectiveness. Rather than sponsor a plethora of basically unconnected projects, by focusing on one or two main themes, (for example the maximization of moisture retention in the brown and dark brown soils zones is the Palliser triangle) individual research stations could conceivably generate tangible, practical findings more rapidly from limited budgets. Farm Lab best exemplified this thematic approach.

Another final aspect of targeting involves, of course, the larger question of relative allocations of funds between various broad research areas. Clearly, in the words of one respondent, soil conservation research remains a "poor cousin" in the larger ensemble of research funded by Agriculture Canada. Various suggestions were made to consultants regarding which programs were currently over-funded to the point of diminishing returns and constituted logical candidates for budget trimming with a view to redirecting funds to soil conservation-related research. Consultants are, however, reluctant within the confines of an overview study of a range of programs to make hard and fast judgements regarding such issues. Suffice it to say that respondents throughout the Prairies region and in Ottawa felt that some reprofiling of funding was probably in order.

One of the problems inherent in trying to shift portions of the existing basket of funds towards soil conservation research consists of the fact that this research does not possess a sufficiently strong and vocal constituency. Consultants were informed that the budget for erosion control, for example, is somewhere in the neighbourhood of the total amount of monies allocated for the control of onion maggots. While this may seem somewhat lopsided, one must bear in mind that a powerful and vocal onion maggot lobby feels strongly that such funding is essential in order to forestall or prevent outbreaks. This very real constituency applies to almost all Agriculture Canada research programs and priorities with the exception of soil conservation, where the economic benefits accruing from such research, or the costs of limiting it, are more subtle and long-term.

It should be born in mind, however, that some soil conservation work takes place within the confines of other envelopes. Be that as it may, soils conservation research is very much underfunded. Finally, a shortage of soil scientists on federally-funded research stations in the Prairie would appear to exist, relative to other disciplines.

However, before any substantial injections of new funds are made, critical attention will have to paid to the manner in which research is conducted. Clearly if a systems-oriented approach is called

for, research will have to be programmed in such a way as to assign priority to routes of research that run counter to the tendency to segment and segregate disciplines, a tendency which affects most scientific research.

2.2.4 Program Design and Administration - The Issues of Planning, Coordination, and Regionalization

One theme raised repeatedly by respondents in research stations concerned the effects of the planning process introduced in the wake of the Lambert Report and the subsequent introduction of regionalization on the management and planning of research at station level. The issue was, more often than not, raised by respondents when asked questions regarding coordination of research.

According to respondents, the planning process centres around the formulation of objectives and quantified productivity targets, targets which, in the opinion of most respondents, are in essence a fiction. According to some scientists interviewed, these targets offer only the appearance, not the reality, of a more precise, cost-effective and targeted approach to research. Officials in Ottawa countered that some form of estimation was required for larger government planning purposes. Furthermore, the specification of objectives had, allegedly, forced many researchers to more precisely define the nature of their work. As to the complaints from researchers regarding excessive paperwork imposed by planning, one respondent in Ottawa opined that irrespective of existing research projects, administrative questions etc., most researchers on stations still had approximately 25 percent of their time free to devote to independent initiatives.

The way in which research priorities are set in the federal system also came under fairly widespread criticism in our field interviews. Many respondents in the field characterized CASSC as a consultative body with insufficient clout. Officials in Ottawa, however, pointed out that a certain amount of dissension in the regions was inevitable: given competing priorities in research, certain hard choices have to be made in Ottawa between those competing priorities.

An in-depth evaluation of the effectiveness and efficiency of the current research process within Agriculture Canada cannot be made

within the confines of this study. Suffice it to say that a certain dissonance currently exists between Ottawa on one hand, and researchers and station directors alike, at the research station level.

Given the apparent rifts and communication gaps that seem to exist between Ottawa and individual stations regarding the utility and effectiveness of the research planning process as it currently exists, consultants have concluded that it warrants a study in and of itself. Research planning and administration processes evolved over a period of years and there is reason to believe that the outcome of that process of evolution requires further fine tuning. On the basis, however, of an overview study which incorporated the range of programs, projects and activities listed at the outset of this report, consultants are reluctant to make too many categorical judgements regarding the planning and administrative process as currently constituted. The level of dissension encountered in the field warrants further investigation.

The issue of regionalization also arose in interviews with scientists and outside experts in each province. The Prairie Research Branch itself was earmarked for evaluation by consultants.

The initial rationale for regionalization of decision-making within Agriculture Canada was to improve coordination among stations, to be responsive to local needs and to deliver cost-effective administrative and management services. Success in fulfilling the promise implicit in this rationale would, it was hoped, allow Agriculture Canada to deliver more and better research results for the taxpayer's research dollar. However, some respondents, both on research stations and in Ottawa, pointed out that regionalization in Agriculture Canada was enacted chiefly as part and parcel of the larger move toward regionalization that swept Ottawa in the early seventies.

Many of the individuals we spoke with argued that the net impact to date of the establishment of a Prairie Region structure may have been negative. In the opinion of scientists and some administrators at research stations, communication among stations and between the stations and Ottawa was better prior to the establishment of the regional structure. In addition, administrative tasks were handled quickly and efficiently at the station level. Management and resource allocation decisions could best be made at individual research stations,

where decision-makers actually had the knowledge of all factors which must be taken into account in the complex process of managing specific projects. In the eyes of many of the researchers, the injection of an intermediate level of bureaucracy served mainly to subject the stations to needless red tape, to delay and distort the flow of information between stations and Agriculture Canada's research management at the national level, and to subject the stations to another level of outside interference. Most scientists to whom questions regarding the administration of research were posed expressed views along these lines. There was only one dissenting view.

The question of regionalization is raised in the context of this study because it tended to be raised by respondents without prompting from consultants. In the final analysis, however, it simply does not lend itself to resolution within the confines of an overview study of soil policy/programs across Western Canada.

3.3 Technology Transfer

It is very difficult to speak of a single system or co-ordinated flow of activities anywhere on the Prairies which, in the opinion of consultants, would constitute a comprehensive, truly "programmed" approach to technology transfer. There seems to be a tendency on the part of decision-makers in various quarters to equate technology transfer with information dissemination, as if the simple provision of information would, in and of itself, necessarily generate significant on-farm changes in cultural practices and techniques.

Certainly, information has a very definite role to play. The way in which it is delivered and packaged can make a very large difference in acceptance levels among farmers. In our study, consultants found some excellent isolated examples of programs which made an effective contribution to technology transfer. A programmed approach was, however, lacking.

At this stage in the discussion, consultants should explain what they mean by a programmed approach. The "idealized" concept of site specific technology transfer shown in Figure 1 is a composite picture pieced together in part as a result of interviews across the Prairies. It also derives from the experiences of team members who,

over the years, have worked intensively on a one-to-one basis with individual farmers in order to address their soil degradation and farm management problems. In essence, Figure 1 provides a skeletal depiction of a "programmed", comprehensive approach to technology transfer.

Figure 1

Simplified,"Linear" Depiction of Site Specific Technology Transfer

Stage I - Research

Interdisciplinary fundamental and applied research Projects; statistically and scientifically valid data; tight management.

Stage II - Education of Extension Personnel

Presentation of concept (in systems context) to soil specialists, ag-reps and farmers.

Stage III - Initial Demonstration and Extension

Hands-on demonstration of concept with early adopters: Government-funded, researcher-supervised.

Stage IV - Widespread Extension and Implementation

General extension by soil specialists in public and private sector on fee-for-service basis.

Note: (1) The essence of this approach is the formulation of a tailored or site-specific management program for each farming unit which:

(a) incorporates all the key soil climatic, economic, financial and human variables.

(b) is compatible with the management capabilities of each farmer or farming group.

(c) Identification of transition implications including (1) Risks, (2) Equipment complement changes and (3) Work scheduling and man-power requirement changes.

Note: (2) Public involvement in the implementation phase. (Fed. & Prov.) could involve grants and or loans for the purpose of easing the transition to conservation cultural practices through:

(a) formulation of the site-specific management program. i.e. consulting and diagnostic services;

(b) Capital investments required to make the transition.

(c) Special crop insurance during transition period.

What is presently missing is a comprehensive, consistent deployment of all of the elements depicted in Figure 1 (particularly stage IV), due to certain weak links in this transfer chain. We will now proceed to briefly expound on each of the above mentioned stages.

2.3.1 Stage I - Research

As depicted in Figure 1, research has to be viewed not only as a program category unto itself but also in the context of the technology transfer process. Most scientists interviewed stressed the critical need to increase the amount of interdisciplinary research taking place in soil conservation. Only in this way, they argued, could research have ultimate real world impacts on individual farms. As discussed in Section 2.2, interdisciplinary research need not necessarily be highly applied in its initial stages. Again, consultants stress the importance of having applied and basic research closely linked.

2.3.2 Stage II - Education of Extension Personnel

Respondents were practically unanimous in the view that the average agricultural representative or district agriculturalist was, by virtue of his rather basic and highly generalized training, ill-equipped to play a hands-on, operational role in delivering soil conservation technology know-how to farmers. Increasingly, agriculture representatives are being perceived less as sources of information regarding soil conservation-related techniques and more as facilitation or liaison personnel. In many instances, farmers are now more technically sophisticated than agricultural representatives. Alberta has perhaps made the most headway in addressing this shift in requirements, by hiring a number of soil specialists who, in terms of level of technical expertise, occupy an "intermediate" position between agricultural representatives and research scientists. Our interviews indicated that a serious shortage of soil specialists exists, not only in Saskatchewan and Manitoba but also in Alberta. Soil specialists will have to be on the "front lines" of delivering site specific, knowledge-intensive techniques which serve to foster soil conservation. Finally, both agricultural representatives and soil specialists should, like physicians, be subject to periodic professional up-grading courses to

ensure that their personal knowledge base keeps pace with new developments.

2.3.3. Stage III - Demonstration and Extension

Consultants uncovered many excellent examples of good demonstration and extension work carried on by individual scientists at research stations across the Prairies. In many instances, however, the level of mission-oriented work by scientists was, in large part, a function of the individual interest taken by a given scientist in working closely with farmers. Farmers often had nothing but praise for individual scientists who work with them and assist them in sorting out their problems. However, they also tended to ruefully point out that these scientists were often exceptions to a general rule. We found that in essence, the transfer of research results via field-days, demonstration plots and other methods to farmers remains generally ad hoc. It depends on the willingness of individual scientists to go public with their research and actively promote it by conducting replicative, site-specific experiment/demonstrations in a particular area. Consultants were repeatedly informed that federal research scientists continue to obtain greater professional recognition and opportunities for advancement within Agriculture Canada by delivering papers at international congresses than through a demonstrated willingness and ability to work with farmers. The widespread use of winter wheat to improve moisture utilization constitutes an excellent example of what a single researcher taking pains to publicize his work and otherwise willing to invest a great deal of time in the transfer of that knowledge to farmers can accomplish.

Farm Lab may be the single most important example of effective on-going demonstration work. Its positive impacts were touched upon in the project profiles provided to the client. Agriculture representatives alleged that a successful Farm Lab-sponsored experiment tended, in the following year, to generate "a very high rate" of adoption within the district in which the experiment/demo took place. Actual statistics on adoption rates are not kept - a distinct shortcoming in view of the need to fine-tune existing technology transfer programs and where necessary, undertake new initiatives. On the basis of the larger poll,

however, consultants concur with the views expressed by agricultural representatives.

2.3.4 Stage IV - Widespread Extension and Implementation

In previous sections of this discussion of technology transfer, we have noted in a general manner existing strengths and weaknesses at each of those stages of our idealized model. The final stage, that of widespread extention and implementation, currently constitutes the weakest set of links in the technology transfer chain. We will now proceed to discuss some of those component links.

A) The Economic Impact of Soil Conservation Consequences for the Technology Transfer Process

It is very difficult to speak of quantifiable economic impacts arising from the current mix of soil conservation programs on the Prairies. In section 2.2, we touched on the problem of cause and effect in determining the impact of research on on-farm agricultural practices. The problem of cause and effect permeates all programs and hence, any attempt to quantify the overall impact of the current mix of survey/monitoring, research technology transfer and other programs to date would be misleading. However, what we can do is provide some preliminary evidence regarding the effects of various conservation practices on the economics of farm operations. This evidence was collected in our interviews across the Prairies, from a survey of some of the literature and finally, from analysis carried out by team members.

To begin with, one must again emphasize the extreme site-specificity of soil problems. Figure 2 provides a telling illustration of this point. We have singled out an example of five farmers interviewed in the Watrous District, Saskatchewan. These farmers had all, in the past five years, adopted conservation farming practices. As shown in Figure 3, each farmer had a distinctive mix of soil problems and crops. The problems were addressed somewhat differently in each instance. In turn, the economic consequences varied from farmer to farmer.

Figure 2.

Technology Changes in Last 5 Years - Five Farmers in the Watrous District, Saskatchewan

	Soil Problem	Crops	Change	Cost	Effect	Info. Sources	Desired Incentives
Farmer I	Increased salinity, loss of organic matter	1850 Acres durham, winter wheat, oil seed	Less summer fallow	$30/Acre reduced cash flow	Still experimental show promising yield increases	Ag. Rep. Farm Lab other farmers	Help cattle industry - need forage to build organic matter
Farmer II	Alkalinity, wind erosion	2500 acres wheat, Durham and forage	Continuous cropping	New air seeder, $60,000	More grain to sell, better for soil, "may not cash flow".	Other farmers, chemical co. rep., Farm Lab ("A-1")	Grain marketing, more Farm Labs
Farmer III	Need to rebuild soil (loss of organic matter)	2200 acres wheat oil seeds, winter	Less summer fallow	$20-50/acre	Worked well until this year (drought)	Field days, extension of U of S, other farmers, suppliers	Tax relief for energy and soil conservation, low interest rates
Farmer IV	Lowered fertility	1250 acres corn, alfalfa	More intensive crop management	?	yields are better, still not making money, marketing is the problem	Sask. Agriculture, other farmers PFRA demo-farm	improved marketing
Farmer V	Organic matter loss, wind erosion, salinity	2140 acres wheat, Durham, flax, 3Y wheat	More fertilizer, spot application of chemicals, continuous cropping	$15,000 capital cost plus $30/acre	cash loss due to drought, "should work in long run if we survive"	Publications, field days, other farmers, private consultants	low interest rates for innovation, equipment rental for winter wheat seeding

Drought conditions have worsened the front-end costs and risks associated with the adoption of conservation farming practices. One Warner County, Alberta farmer speaking on behalf of his fellow farmers, spoke of "saving the soil and losing the farm". However, the same farmer's cash flow losses in the short-term were somewhat offset, in his mind, by the preserved net worth of his land relative to those of his neighbours who had not adopted certain anti-salinity practices such as reduced summer fallow. In fact, the most difficult trade-off facing farmers interviewed in this study consisted of the choice between adopting new conservation-oriented cropping systems which had highly uncertain cash flow consequences in the short-term but which had medium and long-term potential for enhancing soil productivity and output. Farmers who had adopted conservation practices had, in many cases, suffered economically relative to their neighbours who were still employing summer fallow-based soil mining.

At this stage, little exists in the way of economic incentives which would serve to mitigate the front-end economic risks associated with the adoption of certain conservation practices. In our interviews with farmers and agriculture representatives, one key disincentive to the adoption of conservation practices involves the general inadequacy of crop insurance protection currently available. Evidence from interviews suggests that the crop insurance industry is, at best, only slowly and tentatively altering their range of policies so as to recognize both the higher financial risks and higher yield potentials associated with conservation-based cultivation practices. As things currently stand, summerfallow can be viewed as a de facto form of drought insurance.

Marketing of grains and Wheat Board quotas were key issues in our poll. In this context, our interviews with farmers and others boiled down to the following questions: (1) Will conservation technologies increase yields and, (2) will the higher production costs associated with conservation farming be offset by attractive market prices for grain? An analysis conducted by a team member indicates that the net cash flow potential from alternative cropping system is very dependent on grain prices in relation to per unit costs on individual farms. A farmer in the brown or dark brown soils zones should expect at

least a 10 percent increase in cash outlays per unit of production upon changeover from a traditional summerfallow-based "mining" system to a high fertilizer, crop-intensive "conservation" system. This changeover shifts his business into a higher risk position, because higher grain prices will be required to break even on cash flows.

Over the past 15 years, grain markets and prices have been attractive enough to make conservation systems more profitable than soil-mining systems one-third of the time. Conversely, grain markets have been poor enough to make traditional mining systems more profitable a third of the time.

(b) The Psychological/Behavioural Dimensions of the Adoption of Soil Conservation Practices

Not only is the soil conservation problem a very site-specific one, it is also very farmer-specific. Every farmer is a distinct mixture of any number of innate and acquired characteristics. Figure 3 provides a brief summary of those characteristics in schematic form. Addressing the economic issues which currently constrain soil conservation practices is but one precondition to the adoption of those practices. Ultimately, the transfer of soil conservation technology techniques will entail a one-to-one, highly interactive relationship between soil specialists and private sector personnel, research scientists, agriculture representatives and others on one hand and individual farmers and groups of farmers on the other. In our interviews, we found that such factors as ethnic background, age, education level, lifestyles, social acceptability of so-called "recreational tillage" and any number of other factors summarized in Figure 3 have a direct bearing on the propensity of a given farmer to change cultural practices. Technology transfer programs will have to take into account this "market segmentation".

Consultants found a certain amount of inefficiency in the current mix of technology transfer activities, in that we detected considerable overlap and duplication, as well as a somewhat unfocussed use of energies, in the sheer quantity of generalized field days and lectures taking place in a given season, in some agricultural districts. Some of those resources would be best diverted towards working intensively with individual farmers.

(c) A Focussed Approach to Intergovernmental and Interagency Efforts as well as Interaction with the Private Sector.

In our investigations, it became apparent that the most successful instances of widespread conservation technology adoption to date involved farmers taking the first initiative, followed by support of various public bodies. There is, however, little in the way of interdisciplinary delivery of services to farmers co-ordinated among agencies and levels of government. The Warner County experience seems to provide an example of a modicum of co-ordination, but the various government bodies involved seemed to be providing self-contained intra-agency teams, as opposed to contributing specialized talent to inter-agency teams. In our investigations and interviews with extension personnel and farmers, we found no shortage of active curiosity and willingness to implement conservation farming techniques. In some instances, what was missing was full knowledge of the various sources of information and assistance available to farmers.

Farmers are extremely curious and on the whole interested in trying out any technologies and techniques which promise to be economically viable. If anything, one problem to date has been that of farmers taking on new cultural practices with occasionally disastrous results, due to an absence of input from specialists from the private and public sectors and from a misguided attempt to apply mitigating techniques that worked on one site but which proved to be inappropriate to another. That phenomenon in turn points exactly to where both basic and applied research profits from the feedback loop provided by the technology transfer process. The artificial division of labour between research and technology transfer brought about by our federal system must be bridged. Farm Lab provided one prominent example of how these two functions can be synergistically combined.

Public bodies have, in general, been slow to recognize the increasingly important role being played by manufacturers and private consultants in imparting new soil conservation technologies and techniques to farmers. Currently, their potential is not being fully harnessed, as they play only a very limited role in government-sponsored programs. On the whole, respondents felt that by making greater use of private sector based experts in lecture demonstrations, diagnostic

analysis and the provision of site-specific management programs, the impact of public funds could be considerably magnified.

Figure 3

ON-FARM DECISION-MAKING

Personal Characteristics	Farm Management Style	Personal Objectives
. Education	. Skills	. Financial
. Experience	. Adaptability	. (Risk, Return)
. Attitudes		. Lifestyle
. Age		. (Pride, Health,
. Family Status		. Leisure).
. Financial Status		. Conservation
. Cultural Background		

Available Information	Available Resources	FARMING DECISIONS
		- Cropped acreage
- Markets, Prices, Quotas	. Land (Size, Soil	- Fallowed acreage
- Available practices	Type, Climate)	- Foraged acreage
- Taxation/subsidy	- Moisture	- Tillage
- Crop Insurance	- Equipment	- Herbicide use
- Weather	- Financial	- Fertilization
		- Crops seeded use
		- Capital Investments
		- Land Improvements

2.4 Other Aspects of the Technology Transfer Process - Land Conservation Improvement and Reclamation Programs

For this study, consultants evaluated and profiled a number of programs which in many respects, lie outside or are tangential to the technology transfer process as outlined in this section. These programs embodied varying degrees of actual farmer involvement: in some cases, they more closely resembled public works or reclamation schemes. With the exception of PFRA, they were provincially-run. Most were given high marks by respondents for their relevance and accessibility to farmers, public awareness, efficiency and the generation of real, on-farm impacts.

Shelterbelts programs, however, came under some criticism in that they are not always the ideal solution to moisture retention and wind erosion problems, given advances in recent years in the areas of improved tillage, tract management and field design. Also, there is a high maintenance factor associated with shelterbelts due to problems of weed control. Furthermore, shelterbelts, once in place, can interfere with new, large-scale machinery. (By the same token, however, they remain the only option for light sandy soil for which stubble mulching techniques are not consistently adequate.) Finally, many of the trees supplied by federal and provincial agencies (in competition, one should note, with private tree nurseries) are being used for purposes other than soil and moisture conservation (i.e., farmstead beautification). For all of these reasons, shelterbelt programs warrant close monitoring.

Another issue raised was that of the growing danger of overlap and duplication between levels of government in salinity control, due to the as-yet undefined division of labour between PFRA and the provinces in this area. This is particularly the case for Alberta which probably possesses the best developed extension and provincial program delivery system.

4. Knowledge Gaps

In this study, consultants were asked to "make recommendations on how to fill knowledge gaps which currently exist in the evaluation of soil and moisture conservation programs by keying on specific programs or projects identified in Module III". The most important knowledge gap which consultants uncovered consisted of economic impact. More specifically, there remains a lamentable paucity of hard data regarding the actual on-farm impacts of various conservation-related technologies and techniques. Until more is known about the financial impact of the new conservation technology at the individual farm level, the successful incorporation of new technology into a farm business plan and the development and fine tuning of policies designed to further the implantation of such technology will both be impeded. Some of this work ought to be carried out in tandem with applied scientific research. The tillage research taking place at Lethbridge was one of the few examples that consultants found of reasonably comprehensive and thorough economic analysis taking place alongside scientific research. More often than not, the economic analysis which accompanied some of the scientific reports examined by consultants tended to be incomplete.

On the basis of having interviewed a host of different actors, both public and private, for the purposes of this study, consultants have concluded that private businessmen and consultants with a strong understanding of sound farm management practices constitute one group singularly well-equipped to conduct pragmatic, comprehensive and site-specific research into actual on-farm impacts.

As the body of site-specific data increases, extrapolations for wider policy purposes will be possible. The goal of both scientific and economic research should be, over the next few years, to build a sufficiently large body of knowledge to enable policy makers, scientists, technology transfer specialists (both private and public) and farmers alike to develop, however imperfectly (given the inherently site-specific nature of the problems), the beginnings of a "recipe" approach to solving the conservation problems of individual farmers. Until the economic and financial impact issue is better addressed, a crucial gap in our knowledge base regarding soil problems in Western Canada will remain.

5. Concluding Remarks

For the sake of the reader's convenience and the avoidance of overlap, the principal findings of this study are contained in the Executive Summary.

By way of final remarks, consultants would like to again stress that their study was both by design and logistical necessity broad-brush in nature. This final report extracts and highlights key evaluation findings, both positive and negative, which, in the opinion of the study team, must be kept in mind in the design and implementation of existing and future soil and moisture conservation-related programs, as revealed in our investigation of individual programs, project and activities.

We hope that this report provides a conceptual and factual point of departure for the reinforcement of strengths, the correction of weaknesses, and the closer integration of all aspects of the soil and moisture conservation and improvement effort in Western Canada.

APPENDIX 1 - INTERVIEW CHECKLISTS UTILIZED IN THIS STUDY

INTERVIEW CHECKLIST - RESEARCH

1. Could you discuss the overall objectives of your unit's work? What soil and moisture conservation-related projects do you have? What is their rationale as you see it?

2. What are the main directions that you and your colleagues should be pursuing in conservation-related research as you see them?

3. What have been the main achievement(s) of your work to date, as you see them?

4. What percentage of your research budget and person year allocations are accounted for by conservation-related research? It there a trend towards directing more resources to this effort?

5. What percentage of your total soils research effort is related to increasing crop output or soil productivity through increments of energy vs. increasing crop production or soil productivity through soil conservation? Please comment.

6. How much of your research relates directly to more integrated, comprehensive approaches to soil and moisture management on the farm? Please comment.

7. Does your operation contain a technology transfer component? Please give details, outlining what you mean by technology transfer.

8. Could you describe the types of contact (via telephone, pamphlets, media, letters, meetings, visits, other) that you have with local farmers? How many contacts per month with different farmers?

9. Who tends to initiate those contacts, you or the farmers? What do you typically discuss with them?

10. How much contact do you have with survey/mapping/monitoring units? Are they providing you with the information you need? Please explain.

11. How much contact do you have with extension workers (agricultural reps.)? About what? Who tends to initiate these contacts?

12. How much contact and coordination of work takes place with other research units? What is the level? What do you recommend regarding coordination?

13. What are the principal means now employed at this time to disseminate your research findings?

14. Are you satisfied with the extent to which your findings are being disseminated to:

    - farmers
    - extension workers
    - government officials
    - other researchers
    - others

    What improvements would you suggest?

15. What do you expect the economic impact of your research will be on a typical farming operation in your target group?

16. What have been your major or relevant findings?

    Applied

    Unapplied

17. Applied findings: Where have they been used? How do you measure their economic impact? On that basis what were the results?

18. Unapplied findings: Where could they be used? How would their economic impact be measured? What is the estimate of their potential impact??

19. Applied finding: How is their environmental impact measured? What is the estimate of their environment impact thus far?

20. Unapplied findings: What is the estimate of the possible Environmental impact?

21. Do farmers ever provide feedback to you regarding the applications of your research? If so, how do you get this feedback?

    - farmers themselves
    - extension workers
    - colleagues
    - media
    - government officials (specify)

    Would you like to get more? How would you go about getting it?

22. What, in your opinion, are the principal gaps which exist in soil conservation-related research at this time?

23. What difficulties do you experience or anticipate in getting farmers to adopt the techniques utilized in your research?

24. Do you see potential for improving the targetting of research programs? How?

25. Are you aware of instances where work is being needlessly duplicated? Please explain. What do you think can be done regarding duplication of efforts?

26. In your opinion, what are the main constraints or obstacles that you face in your work?

27. Final comments, observations, opinions.

INTERVIEW CHECKLIST - SURVEY/MAPPING/MONITORING

1. What specific soil issues has your work concentrated on?

   - by soil types
   - by soil problems
   - by regions
   - by target population
   - other

2. What are your funding levels for soil conservation related work vs. your overall budget?

3. Could you briefly describe your dealings with research stations and other monitoring units?

4. Could you briefly describe your dealings with extension workers and administrators of assistance/incentive programs in the soil conservation area?

5. Could you briefly describe your dealings with farmers?

6. On what basis do you disseminate your materials or provide your services (i.e., do end-users approach you or do you approach them, or are there distributional intermediairies)?

7. How standardized is your work with comparable work taking place in other areas of the province or in other provinces? Do you coordinate your work with them, or is there any need to do so? Please give specifics.

8. Do you get feedback on your work from various user groups? If so, from whom, and what do they talk to you about? Do you have for any formal mechanisms for feedback?

9. What uses are your maps being put to, besides soil conservation-related ones?

INTERVIEW CHECKLIST - TECHNOLOGY TRANSFER

Program(s) under evaluation: _____

1. What problem areas by soil type do you address? Your target areas? What are the most serious problems in your target area, as you see them? Provide magnitudes.

2. What is the rationale for this program, as you see it?

3. What, in your opinion, have been the achievements of this program(s) to date?

4. Target population, objectives, adoption targets.

5. Extension workers: Where do you get information on new technological/managerial methods?.

6. What types of projects or programs fall under technology transfer? What assistance or incentive programs do you have for farmers?

7. How many different farmers are you directly/indirectly in touch with in an average month? How many field calls/month? What percentage of your target group does this represent?

8. Could you describe your activities in a typical week and percentage of time allocated to each?

9. How do you go about assessing the needs of farmers?

10. What kind of feedback are you getting from farmers regarding the technology transfer programs, or projects currently in place?

11. How do projects get planned and initiated? Are you satisfied with the manner in which they are formulated? Explain. Recommendations.

12. How do you usually make contact with farmers? By and large, do they contact you or do you approach them? (Approximate percentage split)

13. In your experience, how receptive are farmers to new techniques? Explain.

14. How would you suggest improving acceptance levels among farmers?

15. How much contact do you have with a) research establishments, b) survey/mapping/diagnostic establishments? Which ones? How helpful are they to you? Does their work correspond to your needs? To the needs of farmers? What suggestions do you have?

16. In your opinion, is a greater effort required in getting new techniques accepted by farmers? If so, what resources or changes in strategy will be required?

17. In your opinion, what technology transfer approaches or combinations of approaches are the most effective?

18. What impacts do this program(s) have on the economics of running a farming operation? Provide examples by problem and program. How many farms have been affected to date? Provide specific examples by soil problem type and mitigating measure

19. What direct impacts are there programs having on soil quality? Please explain (salinity, organic matter loss, wind erosion, water erosion, compaction).

20. What environmental impacts, if any, are your programs having on neighboring farms, roads, buildings, etc.? Please explain.

21. Where new technology is required to address a soil problem on a given farm, what percentage of it is Canadian content? Is this technology wholly manufactured in Canada or simply assembled here?

22. In your opinion, do some soil conservation programs a) clash, b) overlap needlessly? What are your recommendations?

23. Do you feel that gaps exist in the present array of programs?

24. For Ag. Reps.: List programs in your Province that you work or are familiar with and describe usefulness of each.

25. Final comments, observations, recommendations.

INTERVIEW CHECKLIST - FARMERS

1. Soil type, cultivated acres, cropped acres, crops grown, acres for each type.

2. Please describe your fertility programs. Type, amount, acres. (Identify individual programs)

3. What soil-related problems do you encounter on your farm? Do your neighbours have similar problems? (Identify problems which exist and are specific problems about each.)

4. How much do these problems cost you per year? How much will these problems affect your net worth? Ask a question relating to a symptom of a soil problem which serves as a good indicator of cost. Describe measures the farmer has to take to mitigate the soil problem in order to keep his yields up.

5. Has anyone tried to measure the seriousness of your problems? Did you request assistance? What happened?

6. Have you changed your techniques in order to deal with this problem? If so, what changes did you make and why? If not, why not?

7. How much capital investment was/would be required for that change? What happened/would happen to your operating costs?

8. Did your net farm income increase or decrease as a result of these changes?

9. What effects did/would these changes have on soil quality?

10. What effects did/would these changes have on crop yields?

11. When you want to obtain information on soil-related matters, what are your main sources?

	Yes/No	Frequency	Who initiated Contact	How Helpful	Why
Research Station (which one)					
Extension Workers Ag. Reps. (who)					
Provincial Departments or Offices (where)					
Federal Departments or Offices (where)					
Soil Survey/Monitoring Mapping Services					
Co-ops					
T.V. Radio Newspaper					
Other Farmers					
Farm Organizations					
Private Companies					
Universities					
Other					

12. Do you regularly receive news on new findings or developments in soil conservation? From which sources? Have you made use of this information?

13. At this time, are you being encouraged or asked in any way to adopt new techniques? By whom? What has been your reaction? Why?

14. What is the name of your Ag. Rep.? Location?

15. How often have you contacted him? How often has he contacted you?

16. Did you benefit economically from the information that you received from him?

17. What forms of assistance or incentives are you familar with? Are they of use to you?

18. What kinds of assistance/incentive to adopt new techniques are the most useful to you?

19. Have you made use of soil surveys, diagnostics mapping or other such services? Who provided these services to you? Were they useful? Why?

20. How much confidence do you have in the information that you receive about soil conservation? Please explain.

21. Have you ever had difficulty getting assistance from one source because you were already getting help from another?

22. Do you get too much of one kind of assistance and not enough of another?

23. If you were to list those things that would most likely cause you to change your methods of soil management, what would they be?

24. Final comments, observations, recommendations.

25. For farmers involved in specific programs. Ask questions tailored to the program, formulated on site.

26. List of programs in the province and their usefulness to the farmer.

APPENDIX 2 -

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